

**Action Research Proposal – Peter Muller**

**1. Identification of The Problem**

**a. Problem Statement (Identification of the Central Phenomenon)**

The purpose of this action research project is to increase student confidence and performance in solving math word problems

**b. “Statement of the Problem” (Part 3 in the syllabus)**

For my action research project I want to examine why my students routinely skip word problems so that I can develop strategies to allow them to tackle such problems.

Research suggests that when students are reading a problem in a second language that they attempt fewer problems and have more comprehension errors (Bernardo & Calleja, 2005). I want to explore whether or not my students’ poor English reading abilities have a similar impact and try to find strategies to make the material more accessible for my students.

Bernardo, Allan B. I., & Calleja, Marissa O. (2005). The Effects of Stating Problems in Bilingual Students’ First and Second Languages on Solving Mathematical Word Problems . *Journal of Genetic Psychology*, 166(1), 117-128.

**2. Review of Research**

There is an alarming number of math students in this country who are either unable to solve word problems or do so very poorly and inconsistently, and there are a number of theories about the causes of these difficulties. The two most prevalent of these are poor reading skills and an unwillingness to apply critical thinking skills. Students who have weak reading abilities either have so much difficulty reading the problem that they forget the beginning by the time they finish, or don’t even attempt to read the problem, and just pick out the numbers and guess at the right operation. Critical thinking is another alternative. If students have been trained in disjointed algorithms their entire lives, they don’t know they should, or are even allowed to apply common sense in solving problems. What’s more, even if they wanted to they lack the conceptual frameworks to do so. This essay summarizes the findings of 5 articles that examine why

students have trouble with word problems and explore the effectiveness of some prevention and remediation strategies.

The first article (Danesi, 2007) is an attempt to build upon anecdotal evidence of the success of the Conceptual Metaphor Theory, or CMT, in helping improve student's ability of solve word problems. The researchers attempted to teach student this method of translating word problems by choosing a self selected class of adult "math phobics" and teaching them the CMT framework in the same manner that a previous study had taught 8<sup>th</sup> grade students with some success. While uncontrolled, this study found that at the end of the class the median student was able to successfully answer 9 of 10 word problems, and that all students successfully answered at least 7. The authors concede that much more work needs to be done on the reproducibility of these results, but it is a viable approach to examine.

Fuchs (2008) looked at intervention at an earlier age for problem solving. In this study the authors examined the effects of a specific preventative tutoring regime on the ability of first, second and third graders to solve word problems. Students were screened for this study to identify those with severe deficiencies in both reading and math using diagnostic tests. They were then randomly assigned to either a control group or an experimental group that received additive tutoring in addition to their classroom instruction. The assignment was made at the individual student level rather than the classroom level to eliminate the issue of different classrooms and teachers. They found that the preventative tutoring has a statistically significant impact on performance.

Lee's study (Lee, 2004) examines the root causes of problems in mathematical problem solving. This study performs a series of test on students to determine their problem solving abilities, achievement, and cognitive processing levels. They took

samples of first, second and third grade students to perform these tests and found that student's working memory abilities was highly correlated with problem solving, and could be used to predict word problem solving accuracy completely independent of other factors including both math and reading skills.

Lee is not the only author to see a connection between memory and problem solving ability. Kyttälä (2008) examined both passive and active visuospatial memory and non-verbal intelligence in a normal school population. They randomly selected 15-16 year olds and had them perform mental rotating tasks to measure active visuospatial memory, a Corsi block test to measure passive visuospatial memory, and the Raven Progressive Matrices Test to measure fluid intelligence. Visuospatial working memory (VSWM) was found to be highly correlated with problem solving ability, and those with lower levels of VSWM had lower performance levels. The authors suggest that VSWM can be thought of as a mental blackboard and that if you have less VSWM you can not perform as many mental calculations. They suggest this leaves an opportunity for teachers to encourage students to use visual assistance methods such as drawing pictures or counting fingers.

Bottge (2001) examined the effects video-based problem solving method on remedial and regular pre-algebra students. This study took a sample of 75 students in a rural school split into three different classes, a remedial class, and two separate regular pre-algebra classes. Both the remedial class and one of the regular classes were given instruction using a technology classroom and a special EAI curriculum. This program used an approach that involves video problems and challenge activities. They used pre and post tests to assess both critical thinking and computational abilities of the various classes. They found that while the remedial class did not improve in computational

ability, or even regressed relative to the regular education classes, but that their critical thinking skills improved dramatically. Bottge reports that the creative problem solving activities increase students' attention to the problem and creativity in solving them.

The final articles addressed in this essay look at the effect of language comprehension on performance on word problems. *The Association between Mathematical Word Problems and Reading Comprehension* (Vilenius-Tuohimaa, 2008) examines the relationship between technical reading skills and a student's ability to solve word problems. They administered the ALLU Primary Reading Test to just over 200 fourth graders to determine reading comprehension, used a subtest from this test to determine technical reading ability, and administered a sub test from the NMART Counting Skills Test consisting of 20 word problems to evaluate student's word problem solving ability. The researchers used the technical reading test to separate students into good and bad readers to analyze the results of the other two tests. They found first that the good technical readers had significantly better scores on both the math and reading comprehension tests. Even after controlling for technical reading however, reading comprehension and math ability were still correlated in a statistically significant level suggesting that all three variables are interdependent.

Finally Martiniello (2008) looks at the difference between English Language Learners (ELL) and non ELLs in performance on Massachusetts Comprehensive Assessment System, especially on word problems involving complex language. Martiniello used interviews with children who took the test, as well as test results and linguistic analysis of the wording of questions to show how language comprehension impacts mathematical comprehension.

There are many attempts to explain why students have problems with critical thinking and word problems, and one must be careful in evaluating potential solutions. The cause of the problem is often biased toward the field of expertise of the author and the effectiveness of solutions is often being researched by those who developed them. What does seem to come through the research is that those students who have are successful in other areas seem to be the most successful at solving word problems as well. We can come up with problem solving model after problem solving model, but if the student can not read the problem in the first place it won't matter, and if they are not challenged to think critically and creatively about their world outside of the classroom they will never develop the critical thinking skills they need to truly excel.

**Reference:**

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- Kyttälä, M., & Lehto, J. (2008, March). Some factors underlying mathematical performance: The role of visuospatial working memory and non-verbal intelligence.

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Lee, Swanson H. & Beebe-Frankenberger, Margaret (2004). The Relationship Between Working Memory and Mathematical Problem Solving in Children at Risk and Not at Risk for Serious Math Difficulties. *Journal of Educational Psychology*, 96(3), 471-491.

Martiniello, M. (2008, Summer2008). Language and the Performance of English-Language Learners in Math Word Problems. *Harvard Educational Review*, 78(2), 333-368.

Vilenius-Tuohimaa, P., Aunola, K., & Nurmi, J. (2008, August). The association between mathematical word problems and reading comprehension. *Educational Psychology*, 28(4), 409-426.

### **3. Research Questions**

#### **a. Central Question**

What factors contribute to my Algebra II students routinely skipping word problems?

#### **b. Sub-questions**

How is performance affected by problems delivered orally?

Do students connect word problems to algorithms learned in class?

How does social pressure, affect performance in different social settings?

Does performance on non-word problem questions impact confidence on word problems?

Does an the relevance of the word problems to students' lives affect performance?

### **4. Overview of research methods that will be used**

The central component of my research project will be tests given to my students. All students will take a test assessing their ability to follow algorithms learned in class followed by tests containing different types of word problems on the same topic. There will be four different versions of the test, written word problems with simple language, at a level my students speak at, one with written word problems that are simple math but complex language, and an oral version of

each. All of my classes will be given all versions of the test but different classes will be given them in different orders.

There will be three types of data collected from this study. The first will be the tests themselves as documents for examination. During the test I will be moving around the room taking notes on student effort, body language, level of written work and overall reaction to the questions. After the tests I will interview students in small groups of four or five and ask them to describe how they thought about the questions and how they felt about them. This will be a fairly unstructured interview and I will allow the group to feed off of itself.

### **5. Overview of how the data will be used**

The central question will be primarily addressed by the group interviews. Questions posed to the students about their experience will probe level of confidence as well as lines of thought and evidence of careful reading. Social pressures related to performance will be assessed by a comparison of comments made by individual students in these sessions with their actual performance with an eye to inconsistencies between what they say and their results. Their ability to apply algorithms to word problems will be assessed by comparing their results on the non-word problems to the word problems. A significant difference will indicate it is the word problems that are the hang up, if scores are similar than the problems are probably more computational. These findings will be supported by interview responses and observations.

I will also be looking at attitude. I have anecdotally noticed some students are great at computation but do not attempt problem solving, while others are lost on algorithms but can solve the same problems through their own methods when given context. Through comparing results on both types of questions to their interview comments about what problems they prefer and why I hope to more fully develop the nature of that relationship.

Some of the questions will address how much of the problems they understood and if they had ever had any experiences like those in the word problems. Using these responses I will identify the questions they consider the most relevant, and those which they consider least relevant and compare those results to the accuracy levels on those same questions.